III. "On the Discharge of Electricity produced by the Röntgen Rays, and the Effects produced by these Rays on Dielectrics through which they pass." By J. J. Thomson, M.A., F.R.S., Professor of Experimental Physics, Cambridge. Received February 7, 1896.

The Röntgen rays, when they fall upon electrified bodies, rapidly discharge the electrification, whether this be positive or negative. The arrangement I have used to investigate this effect is as follows:—The Ruhmkorff coil and the exhausted bulb, used to produce the rays, are placed inside a large packing case covered with tin plate; this is done to screen off from the electrometer any electrostatic disturbance due to the action of the coil. The needle of the electrometer is suspended by a quartz fibre; thus, as there is no magnetic control, the needle of the electrometer is not affected by changes in the magnetisation of the core of the coil.

The exhausted bulb is placed so that the phosphorescent part of it is about $1\frac{1}{2}$ inches from the top of the box, and a hole about an inch in diameter is cut in the lid of the box just over the bulb, so as to allow the rays to emerge from the box; a thin plate of either aluminium or tin-foil is used to cover up the hole. The electrified plate, which is a little larger than the hole, is placed outside the box about 2 inches above the hole in the lid, so that the Röntgen rays which passed through the hole fall upon the plate. This plate is kept permanently connected with one of the quadrants of a quadrant electrometer; the greatest care is taken with the insulation of this plate and of the quadrants of the electrometer. The insulation was so good that there was no appreciable leak when the coil was not in action. The following is the method of making the experiments: The two pairs of quadrants are connected together and the plate charged to a high potential by an electrophorus or by temporary connection with a large battery of small storage cells. All the quadrants of the electrometer are now at the same potential. The two pairs of quadrants are now disconnected; if the insulation is good the potentials will remain the same, and there will be no deflection of the electrometer; in our experiments the leak is so small that under these circumstances the movement of the spot of light is hardly perceptible. If, now, the Röntgen rays are directed on to the plate a violent leakage of electricity from the plate occurs, the potential of the quadrants connected with the plate changes, and in a few seconds the spot of light reflected from the mirror of the electrometer is driven off the scale. This leakage of electricity occurs whether the plate is positively or negatively electrified; if the plate is uncharged

to begin with, I have not been able to detect that any charge is acquired by the plate by exposure to these rays. When the potential to which the plate is raised is high the leakage from the plate is a most delicate means of detecting these rays, more so than any photographic plate known to me. I have found these rays produce distinctly perceptible effects on a charged plate after passing through a zinc plate a quarter of an inch thick. The charged plate and electrometer are much more expeditious than the photographic plate and more easily adapted to quantitative measurements.

To determine how the radiation of the Röntgen rays depended upon the degree of exhaustion of the bulb, the bulb was kept in connection with the pump and the leakage was observed at different degrees of exhaustion; no leakage could be detected until the pressure was so low that phosphorescent patches appeared on the bulb, and, even after the phosphorescence appeared, the leakage was small as long as there was any considerable luminosity in the positive column; it was not until this had almost disappeared that the leakage from the charged plate became rapid.

If the greatest sensitiveness is required, it is, of course, advisable to charge the plate as highly as possible. The leakage due to the rays, however, occurs when the potential of the plate does not exceed that of the tin-plate cover by more than 3 or 4 volts, and I have not yet met with any phenomena which suggest that there is a lower limit of potential difference below which leakage does not take place.

This leakage differs from that produced by ultra-violet light, the laws of which have been unravelled by Elster and Geitel, in several essential features, in the first place ultra-violet light only discharges a negative charge, while the Röntgen rays discharge both positive and negative. Again, the effect of ultra-violet light is only considerable when the electrified body is a strongly electro-positive metal with a clean surface. The effects of the Röntgen rays are, on the other hand, very marked whatever the metal, and take place when the electrified plate is surrounded by solid or liquid insulators as well as when surrounded by air. I have embedded the plate in solid paraffin wax, in solid sulphur, placed it inside a lump of ebonite, wedged it in between pieces of mica, and immersed it in a bath of paraffin oil; in each of these cases, though the insulation was practically perfect when the insulator was not traversed by the Röntgen rays, and the potential of the plate differed from that of the metal covering of the box by from 10 to 15 volts, yet, as soon as the Röntgen rays passed through the insulator, the charge of the metal plate leaked away. I have found that the electricity leaks from the plate even when the space between it and the nearest conductors connected to earth is entirely filled with solid paraffin; hence we conclude

that when the Röntgen rays pass through a dielectric they make it during the time of their passage a conductor of electricity, or that *all substances when transmitting these rays are conductors of electricity.* The passage of these rays through a substance seems thus to be accompanied by a splitting up of its molecules, which enables electricity to pass through it by a process resembling that by which a current passes through an electrolyte. By using a block of solid paraffin in which two pairs of electrodes are embedded, the line joining one pair being parallel, that joining the other pair perpendicular, to the Röntgen rays, which were kept passing through the block, I found that there is but little difference between the rate of leakage along and perpendicular to the rays.

I have much pleasure in thanking Mr. J. A. McClelland, of Trinity College, Cambridge, and Mr. E. Everitt for the assistance they have given me in carrying out these experiments.

A telegram from Professors Borgman and Gerchun, of St. Petersburg, forwarded by the editor of the 'Electrician,' to the effect that Röntgen rays discharged electricity, and a letter from Professor Lodge to the effect that he had definitely ascertained that the phosphorescent glass was the source of the radiation of Röntgen rays, and that the radiation starts in all directions, and not normally only from the glass, were read.

IV. "On the Absorption of the extreme Violet and ultra-Violet Rays of the Solar Spectrum by Hæmoglobin, its Compounds, and certain of its Derivatives." By ARTHUR GAMGEE, M.D., F.R.S., Emeritus Professor of Physiology in the Owens College, Victoria University. Received February 11, 1896.

In the year 1878 the late Professor J. L. Soret, of Geneva, in his first memoir on the absorption of the ultra-violet rays of the spectrum by diverse organic substances,* announced the fact that diluted blood, when examined with the aid of a spectroscope provided with a fluorescent eye-piece, presented in the extreme violet, between Fraunhofer's lines G and H, an absorption band which appeared to him to be slightly shifted towards the less refrangible end of the spectrum when the blood solution was saturated with carbonic oxide. Soret subsequently† confirmed the accuracy of the above

* J. L. Soret, "Recherches sur l'Absorption des Rayons ultra-violets par diverses Substances," 'Archives des Sc. Phys. et Nat.,' vol. 61 (Geneva, 1878), pp. 322—359.

† Soret, 'Archives des Sc. Phys. et Nat.,' vol. 66 (1883), pp. 194, 195, and 204.